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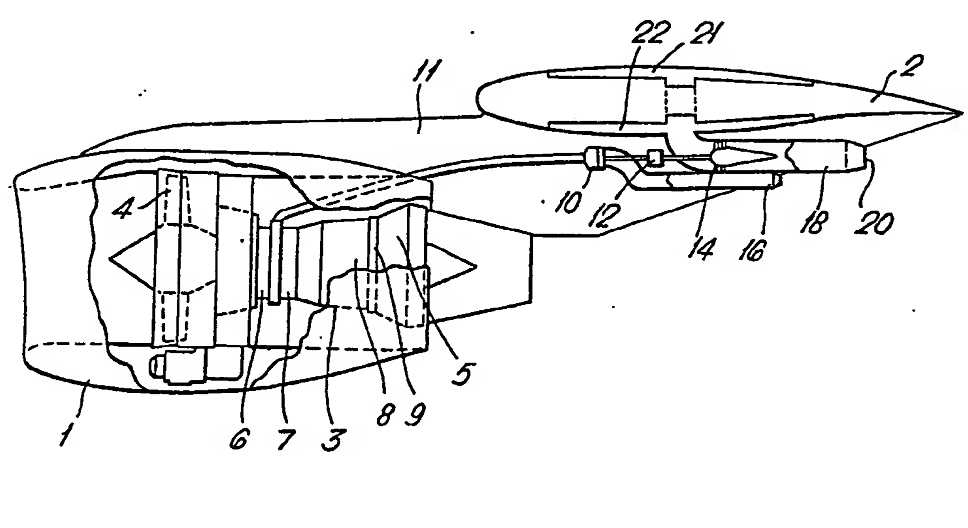
(54) Remote power system for aircraft

(57) In multi-shaft gas turbine engines the high pressure system is usually small relative to the low pressure system and is becoming increasingly sensitive to power off-takes in the form of bleeds for aircraft purposes or shaft power for accessory drives, particularly at altitude. The present invention modifies the aircraft auxiliary power unit or starter unit, which is in the form of a small gas turbine engine (10) for use at altitude by providing a bleed from the intermediate compressor (6) of the engine to supercharge the intake of the unit thus giving it a higher overall pressure ratio. The unit is then arranged to drive into a reduction gear (12) from which power is taken to drive an auxiliary fan (14) which is used for boundary layer control of the aircraft wing (2), or fuselage, or for blowing of aircraft flaps or augmentor wings. Alternatively power from the reduction gear is used to drive an accessory gearbox.

Fig. 1.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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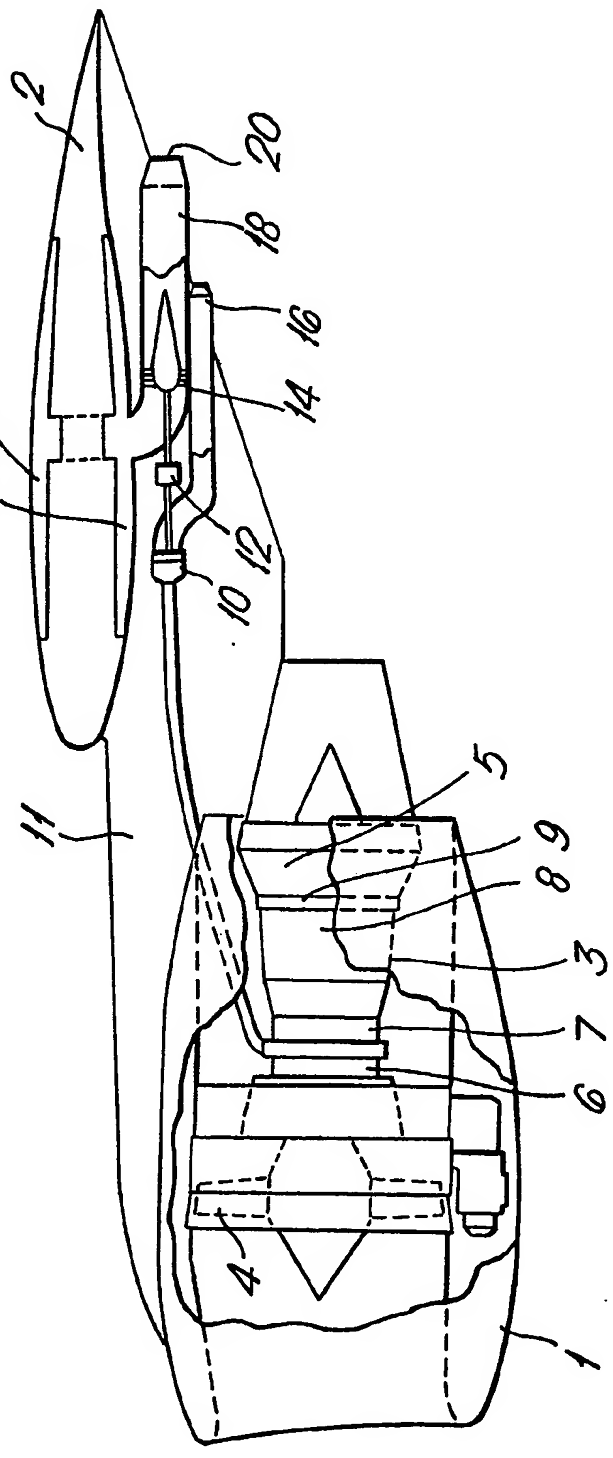

Fig.1.

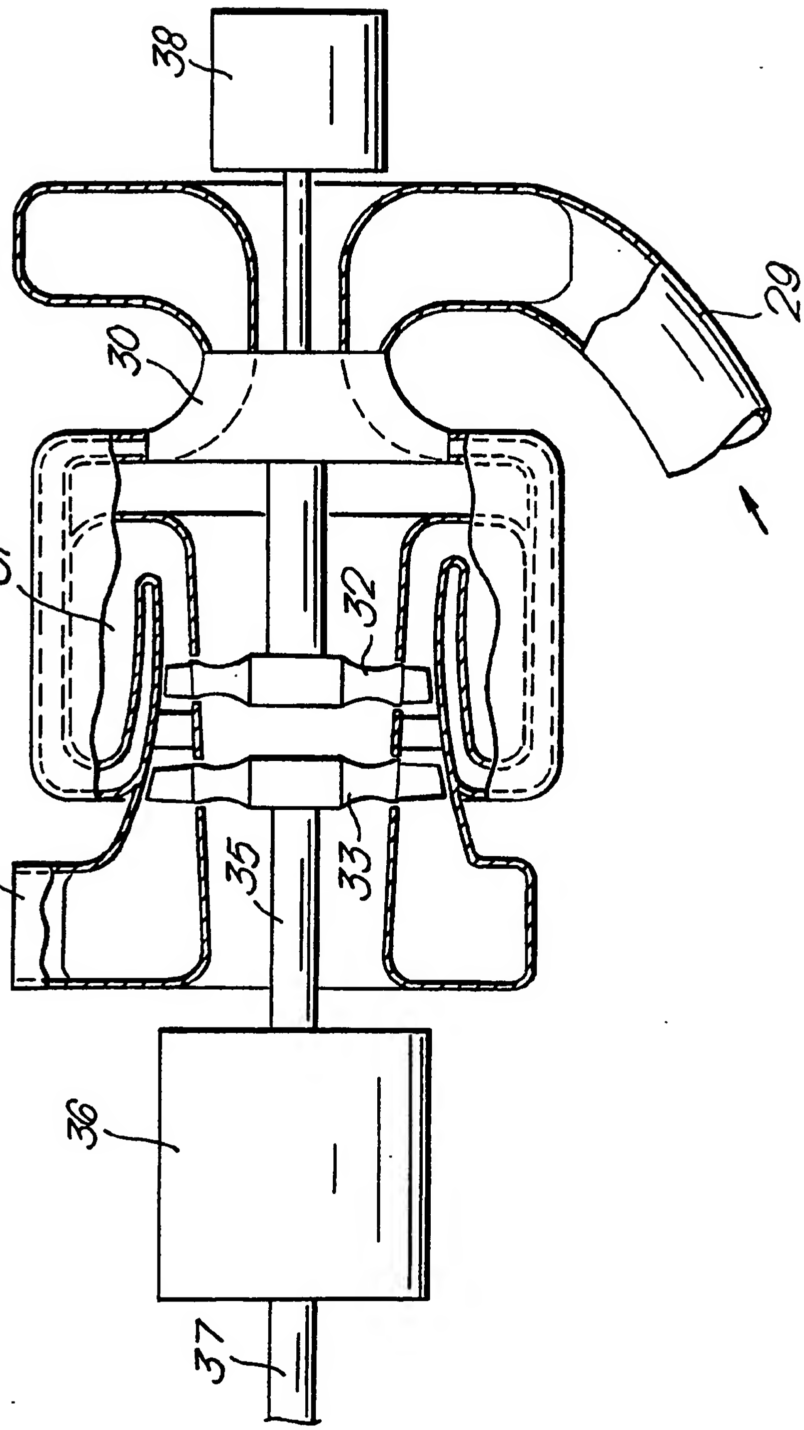

Fig. 2.

SPECIFICATION
Remote power system

The present invention relates to a remote power system for providing remote power for various purposes in aircraft or in aircraft engines during aircraft flight.

It is known, for example, from our UK Patent No. 1,305,976 to use air bleeds from aircraft gas turbine propulsion engines to energise flaps on aircraft wings. It has also been previously proposed to use such bleeds to control boundary layers on aircraft wings or fuselages by creating suction to suck the air on the wing or fuselage through slots in the surface thereof.

These devices, while increasing the efficiency of the aircraft wings under various operating conditions, or reducing the drag on the fuselage of an aircraft, usually require significant quantities of compressed air from the engine which reduces the efficiency of the propulsion engine. The problem is that the high pressure system of a conventional multi-shaft is usually small in relation to the low pressure system and as engines are being designed to operate at higher temperatures for greater thermal efficiency, the high pressure system is being increasingly used to provide bleeds for cooling of discs and blades within the engine. This makes the high pressure system very sensitive to additional bleeds for aircraft purposes and also to any power other off-takes required, for example for driving engine accessories such as fuel and oil pumps generators and the like and at altitude the ability of the high pressure system to provide such power off-takes is approaching its limits.

The present invention provides a solution to both of these problems. Most aircraft carry an auxiliary power unit or starter unit which consists of a small independent gas turbine engine. In some cases these units provide emergency power when failure of a main engine occurs.

With the present invention an auxiliary power unit is modified by the provision of a bleed from an engine compressor which is supplied directly to the intake of the unit to supercharge the unit, and the power turbine is arranged to drive an output shaft capable of providing remote power, either to a fan for providing the air for boundary layer control of the wing or fuselage, or for driving the engine or aircraft accessories.

According to the present invention a remote power system for an aircraft having at least one main propulsion engine comprises a gas turbine auxiliary power unit having a power turbine, and is characterised in that the intake of the auxiliary power unit is supplied with air bled from a compressor of the main propulsion engine and the power turbine is connected to drive an output shaft capable of providing remote power for aircraft or main engine requirements during aircraft flight.

The auxiliary power unit will be a relatively small gas turbine engine in comparison to the main propulsion engine and will, in general, operate at high speed. The output shaft preferably drives into a reduction gear from which the power off-take is made.

By supercharging the auxiliary power unit from the main propulsion engine the unit is given the capability to operate at all altitudes so that boundary layer suction can take place at aircraft cruising altitudes thus producing an energy efficient aircraft. Also the power from the auxiliary power unit is available just when the high pressure shaft of the engine is reaching the limits of its capability to drive accessories.

Alternatively, since the supercharging of the auxiliary power unit for altitude operation gives it a higher overall pressure ratio, it will also be capable of producing more power at low altitude which can be used for example, for flap blowing or augmentor wing systems.

The bleed from the main propulsion engine is preferably taken from a low pressure or an intermediate pressure compressor of the engine which is least expensive in terms of propulsion engine efficiency.

The invention will now be more particularly described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 illustrates an aircraft engine mounted beneath a wing, and an auxiliary power unit of the present invention arranged to produce boundary layer suction on the wing surfaces, and,

Figure 2 illustrates in more detail one form of auxiliary power unit of the present invention driving a reduction gear.

Referring now to the drawings there is shown in Fig. 1 one of a plurality of gas turbine engines 1 mounted beneath a wing 2 of an aeroplane (not shown).

The gas turbine engine 1 may be of any known type, and is illustrated as a ducted fan engine having a core engine 3 driving a fan 4 via a fan turbine 5. The core engine in this example includes an intermediate pressure compressor 6 mounted on the same shaft as, and driven by the fan turbine 5, together with a high pressure compressor 7, combustion equipment 8 and a high pressure turbine 9.

An auxiliary power unit 10 is mounted from the main engine mounting structure 11 alongside the wing 2 and consists of a compressor 30, a combustion section 32 and a compressor-driving turbine 33 all of which may be of conventional form (see Figure 2). A power turbine 34 (Fig. 2) is added downstream of the compressor-driving turbine and is coupled via a gear box 12 to drive an auxiliary fan 14. The exhaust from the power turbine is directed rearwardly of the aircraft via a propulsion nozzle 16 and adds to the thrust of the engines 1 on the aircraft. Thus the power turbine is capable of producing remore power i.e. power in addition to main propulsion engine power for various aircraft or main propulsion engine uses.

The auxiliary fan 14 is supported in a duct 18 within the wing and engine mounting structure, and is arranged to draw air from the interior of the wing and to exhaust it rearwardly through a

nozzle 20. Areas 21 and 22 of the wing surface are perforated, or slotted, so that the boundary layer on these surfaces is sucked into the low pressure region within the wing 2. Clearly the fan 14 may be arranged to operate in similar manner to control the boundary layer on the aircraft fuselage.

In order to increase the pressure ratio across the auxiliary power unit 10 the intake to the compressor of the unit is fed with air bled from the intermediate pressure compressor 7 of the main propulsion engine. This enables the auxiliary power unit to operate efficiently at all altitudes in the flight envelope of the aircraft so that boundary layer suction can take place at the cruise altitude of the aircraft.

In order that the auxiliary power unit 10 may be operated at will without seriously affecting the matching of the compressors of the main engine 1 as the air bleed is turned on and off, the fan 5 of the main engine may be a variable pitch fan as is known per se.

The auxiliary fan 14 has been shown providing suction in the aircraft wing for boundary layer control, but it should be understood that the air compressed by the fan 14 could alternatively, or even simultaneously be used to power blown flaps on the wing or an augmentor wing arrangement. In such an embodiment, operation at altitude is of less importance than deriving maximum air flow from the fan 14, so that the increased pressure ratio provided by the supercharging of the unit from the main engine may be used to drive a larger power turbine.

Figure 2 illustrates a type of small gas turbine engine which may be used as an auxiliary power unit. The engine consists of a centrifugal compressor 30 supplied with air from an intake duct 31 which is in turn supplied from the compressor 7 of the engine 1. From the compressor 30 the air passes to a reverse flow combustion system 1 and then to a compressor-driving turbine 2. The exhaust from the compressor-driving turbine passes to a power turbine 3 and then to exhaust via a duct 4.

The power turbine is mounted on a shaft 35 which forms the input to a reduction gear 36. In this embodiment the output from the reduction gear is a further shaft 37 which is connected to drive into an accessory gear box on either the main propulsion engine or the aircraft.

Control for the auxiliary power unit is provided by a control unit 38.

It will be understood that auxiliary power units per se are well known and are not described in detail in this specification. The invention consists in the arrangement and use of the power unit as a remote power generator for continuous operation at any aircraft altitude.

CLAIMS

1. A remote power system for an aircraft having at least one main propulsion engine, comprises a gas turbine auxiliary power unit having a power turbine, and is characterised in that intake of the auxiliary power unit is supplied with air bled from a compressor of the main propulsion engine, and the power turbine is connected to drive an output shaft capable of providing remote power for aircraft or main engine requirements during aircraft flight.

2. A remote power system as claimed in claim 1 and in which the output shaft drives into a reduction gear and, the output from the reduction gear comprises a further shaft for providing said power.

3. A remote power system as claimed in claim 1 or claim 2 and in which the output shaft, or said further shaft is connected to drive a fan.

4. A remote power system as claimed in claim 3 and in which the intake to the fan communicates with a chamber within the aircraft wing or fuselage and into which air from the boundary layer of the flow over said wing or fuselage is drawn through slots or apertures therein.

5. A remote power system as claimed in claim 3 and in which the delivery from the fan is directed over or between flaps on the aircraft wing.

6. A remote power system as claimed in claim 2 and in which said further shaft is connected to drive into an accessory gear box of either the aircraft or the main propulsion engine.

7. A remote power system substantially as hereinbefore described with reference to the accompanying drawings.

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